TDI

Transistor Devices

DLVP-50-300-3000A

Operator's Manual

DYNALOAD DIVISION

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1.0 INTRODUCTION

The Dynaload is a precision instrument which simulates electrical loads to test power supplies, generators, servo systems, batteries, and similar electrical power sources. It simulates, at the option of the user, resistive loads (amps/volt) or may be switched to a constant current load characteristic (current regulated at a pre-selected value) or a constant voltage type of load (similar to a battery or a zener diode). Provisions are also made for external programming in automated test set ups. The external programming voltage is from 0-10V with an input impedance of 10K minimum. Load current is directly proportional to programming voltage, and the sensitivity is adjustable with the front panel current adjustments.

In addition to the constant current external programming, the Dynaload may be programmed by an external resistance to function as a resistive load. The load resistance is inversely proportional to the programming resistance.

The pulse load may be varied in frequency and 10-100% duty cycle (pulse width). Frequency ranges are 20-200 Hz, 100-1000 Hz, and 500-5000Hz.

Pulse amplitude is independently controlled and may be added to a preselected DC current by the combination of the front panel controls. The meter normally reads peak pulse current, so the DC current should be preset, and the pulse current is the difference between peak reading and the previous DC reading. The output of the internal pulse generator is available at the rear panel (TB1-1). The pulse wave-shaping circuitry between TB1-1 and TB1-2, which are normally jumpered together by a clip on the terminal block.

The circuit breaker used to connect the source to the power devices in the load is electronically controlled and senses overcurrent, over dissipation (volts x amps), and overvoltage.

In the event of an overvoltage or overtemperature condition, protection circuits open the electronic circuit breaker. In the event of an overcurrent or overpower condition, circuitry is activated to limit the load current, and a front panel "power limit" LED is lit. If the current and power are increased further, protective circuitry will open the electronic circuit breaker. The power transistors are turned off prior to the circuit breaker opening.

2.0 SPECIFICATIONS

THE FOLLOWING RATINGS APPLY:

LOAD VOLTAGE: 0 TO 50V
LOAD CURRENT: 0 TO 300A
POWER DISSIPATION: 0 TO 3000W
OVERLOAD RATING: 20%
SELF-PROTECTION -- OVERVOLTAGE: <60V
OVERCURRENT: <350A
OVERPOWER: <3500W

2.1 MODE SELECTOR SWITCH POSITION
(From left to right)

POSITION 1: Constant resistance 0-20 A/V as determined by the front panel DC load adjust

POSITION 2: Constant resistance 0-60 A/V as determined by the front panel DC load adjust

POSITION 3: Constant current 0-60A as determined by the front panel DC load adjust

POSITION 4: Constant current 0-300A as determined by the front panel load adjust

POSITION 5 AND POSITION 6: A variable duty cycle pulse load with 0-60A and 0-300A ranges. The frequency ranges of 20-200, 100-K, and 500-5K are selected by the three frequency range switches directly above the pulse load range switches.

POSITION 7: External modulation -- will program from 0-3000A with 0-10V applied to the external modulation terminals (TB1-1 and TB2-5). Modulation sensitivity is directly adjustable by the front panel DC load adjust control.

POSITION 8: Constant voltage load. In this position, the load is similar to a battery being charged or a constant voltage zener diode; no current is drawn until the source voltage reaches the regulating voltage. The voltage at which the Dynaload regulates is adjust-adjustable by the front panel volts control.

2.2 FRONT PANEL CONTROLS

S1: AC ON/OFF switch and indicator lamp

S2: DC load ON/OFF switch and indicator lamp

M1: Load current range as selected by front panel current range select switch, 0-6V, 0-18V, or 0-60V

S3: Short current switch.

M2: Load current range as selected by front panel current range select switch: 0-36A, 0-120A, or 0-360A

N O T E

WHEN TESTING LOW CURRENT SOURCES, IT MAY BE ADVISABLE TO USE AN EXTERNAL FUSE OR CIRCUIT BREAKER TO PROTECT THE SOURCE.

C A U T I O N

THE METER RANGE SELECTOR SWITCH SHOULD ALWAYS BE MANITAINED IN THE HIGHEST VOLTAGE OR HIGHEST CURRENT POSITION EXCEPT WHEN READINGS ARE BEING TAKEN. ALTHOUGH THE METERS HAVE HIGH OVERLOAD CAPABILITY, THEY MAY BE DAMAGED BY OVERLOADS IN THE LOWER RANGE POSITIONS.

CURRENT SAMPLE: This is provided for measuring the pulse current amplitude when operating in the pulse mode. The current sample output is factory calibrated for 20mV per 100 amps load current or .20 millivolts per amp.

SYNC OUT: This is a pulse output which is of the same frequency as the internal pulse generator, and may be used to trigger an oscilloscope.

PEAK AVERAGE SWITCH: This switch places the ammeter control circuitry in either a peak pulse current reading or an average current reading mode.

DC LOAD CURRENT ADJUST: Course and fine adjust contols with a 10 to 1 ratio for precisely setting the load current for the constant current and amps/volt ranges. This control is also functional in the pulse mode to adjust the DC load component.

PULSE LOAD CURRENT ADJUST: Course and fine adjust controls for the 0-60A and 0-300A pulse ranges.

RATE/WIDTH CONTROLS: The rate control continuously adjusts the frequency of the pulse within the frequency range selected. The width control adjusts the duty cycle of the pulse from 10% to 100%.

VOLTS CONTROL: In the constant voltage mode the control sets the threshold voltage at which the Dynaload will regulate the voltage present at the input by drawing the load current required to bring the voltage down to the value set. The knee of the threshold is approximately 500 A/V.

2.3 REAR PANEL CONNECTIONS: -- TABLE 1

REAR PANEL CONNECTIONS	
E+	PLUS LOAD. CONNECT TO THE POSITIVE TERMINAL OF THE SOURCE TO BE TESTED.
E-	MINUS LOAD. CONNECT TO THE MINUS TERMINAL OF THE SOURCE TO BE TESTED.
TB1-1	OUTPUT OF THE PULSE GENERATOR.
TB1-2	INPUT TO PULSE LOAD RANGE SWITCHES. TERMI- TERMINALS TB1-1 AND TB1-2 ARE NORMALLY JUMPERED TOGETHER.
TB1-3	EXTERNAL MODULATION INPUT. CALIBRATED FOR 30A PER 1 VOLT INPUT.
TB1-4	10V REFERENCE FOR USE AS PROGRAMMING VOLTAGE.
TB1-5	RESISTANCE PROGRAMMING. ACCESS PIN TO FRONT PANEL DC LOAD ADJUST POTENTIOMETER. MODE SELECTOR SWITCHES TO THE A/V RANGES.
TB2-1	STATUS INDICATION OF ELECTRONIC CIRCUIT BREAKER MODE. WITH CIRCUIT BREAKER CLOSED, A 5V SIGNAL WILL BE PRESENT AT THIS PIN. WITH THE CIRCUIT BREAKER OPEN, NO VOLTAGE WILL BE PRESENT.
TB2-2	DC ON. A SHORT FROM THIS PIN TO CIRCUIT COMMON WILL CLOSE THE CIRCUIT BREAKER.
TB2-3	DC OFF. A SHORT FROM THIS PIN TO CIRCUIT COMMON WILL OPEN THE CIRCUIT BREAKER.
TB2-4	SHORT. THE SHORT CIRCUIT CONTACTOR CAN BE ENERGIZED BY PULLING THIS PIN TO CIRCUIT COMMON. THE SHORT CIRCUIT WILL REMAIN AS LONG AS THE PIN IS KEPT LOW.
TB2-5 NOTE*	CIRCUIT GROUND IS THE CONNECTION TO THE CURRENT REGULATORS CIRCUIT COMMON AND IS ELECTRICALLY CONNECTED TO THE E-STUD.
F1	AC LINE FUSE A1, SB.

NOTE*: THE CONTROL OF THE CIRCUIT BREAKER REQUIRES ONLY A MOMENTARY CONNECTION TO THE CIRCUIT COMMON TO CHANGE THE STATE OF THE BREAKER. THE PROTECTION CIRCUITRY IS NOT ALTERED BY THESE CONTROL PINS OR THE FRONT PANEL DC LOAD-ON SWITCH. THE CIRCUIT BREAKER AND SHORT CIRCUIT CONTROL PINS REQUIRE LESS THAN 10MA TO CIRCUIT COMMON.

3.0 OPERATING INSTRUCTIONS

The following procedure is recommended for connecting the Dynaload:

A. Set the AC and DC Dynaload ON/OFF switches to off.

B. Set the meter range switches in their maximum voltage and current positions.

C. Set the load adjustments controls in the counter-clockwise position.

D. Set the mode selector switch to the desired mode.

E. Connect the Dynaload to a standard 115V, 50-60 Hertz power source (optional input voltage ranges are available),

F. Connection the source to be tested to the load terminals of the Dynaload. E+ and E- on the rear of the unit.

G. If external modulation is to be used, the external programming voltage should also be connected.

H. Set the AC power switch to ON, the AC ON indicator lamp should light.

I. The DC ON circuit breaker should now be actuated by pressing the momentary contact "DC LOAD-ON" switch.

J. The front panel Dynaload voltmeter should indicate the source voltage.

K. If the circuit breaker does not close, or if there is no indication of source voltage, check the external connections for voltage and polarity.

L. The load may now be increased by turning the load adjust controls slowly clockwise until the appropriate load is obtained.

M. The meter range switches may be switched to the lower scale positions if greater accuracy is required, and external instrumentation may be used to obtain further accuracy and eliminate the effects of line voltage drops at high currents.

3.1 CONSTANT RESISTANCE MODE (AMPS/VOLT)

Two scales are provided: 0-20 A/V and 0-60 A/V. Minimum resistance on the 0-20 A/V is 0.05 ohms, and minimum resistance on the 0-60 A/V is 0.016 ohms. For example, to test a 12V battery with a two ohm resistive load:

A. Set the mode selector switch to the 20 A/V position.

B. Adjust the coarse and fine load adjusts to obtain the 6A load.

C. The two ohm load is now set, and this resistance value will remain constant for the full range of input voltage.

The resistive load characteristics of the Dynaload simulate a pure resistance down to approximately 1 to 2 volt input; for a given resistance setting, the current is directly proportional to the voltage over wide dynamic ranges. In the very low voltages, the power transistors will saturate.

3.2 CONSTANT CURRENT MODE

Some power sources, such as variable power supplies, are rated at a fixed maximum load current and adjustable over a predetermined voltage range (for example, 5-30V @ 20A). If the resistive load characteristic were used for this type of test, it would be necessary to reset the load each time the power supply voltage was changed in order to maintain the full load current. However if the load is set to the 0-60A range, and a load of 20A is applied, then the power supply can be adjusted from 5-30V, and the load current will remain constant.

It should be noted that many solid state power supplies are designed for short circuit protection by internal current limiting and bendback, and therefore, may not start up into a constant current type of load. Accordingly, the constant resistance characteristic should be used as a load when simulating short circuit protection and recovery of most solid state power supplies unless otherwise specified by the manufacturer.

3.3 EXTERNAL MODULATION

In the external modulation mode, the Dynaload acts as a constant current load with the constant current proportional to the external voltage applied to TB1-3 and TB1-5.

The Dynaload will program from 0-300A if the DC load adjustments are set in the maximum clockwise position. The programming sensitivity may be reduced proportionately by the front panel DC load adjust controls. Turning the load adjust counterclockwise reduces the programming sensitivity. The input impedance of the external modulation terminals is approximately 10K ohms.

The linearity of the external program is set to be within 2% above 1A.

The transient response of the Dynaload is determined by the feedback loop characteristics of the constant current regulator to achieve precision programming.

3.4 PULSE MODE

The pulse load may be varied from 0-50A or from 0-300A peak current by the pulse amplitude control on the front panel. The frequency may be varied from approximately 20-5000 Hz by the pulse frequency control and range switches on the front panel. This pulse load may be superimposed on top of a constant DC load, which may be selected by the DC load control on the front panel.

If the pulse is to be used down to a no-load state, the DC load controls should be turned fully counterclockwise. The maximum total of the pulse and DC load will be limited around 320A by the internal current limit protection.

The rise time of the load current pulse is approximately 50 us for 0-300A. If this is too fast for the application, the wave form may be altered by inserting a network between TB1-1 and TB1-2.

The DC pulse load may be mixed in any combination through the use of the separate DC load course and fine and the pulse load coarse and fine controls. When the 0-60A pulse mode is used, the DC load control is calibrated to a 0-60A range. The 300A range functions similarly.

3.5 CONSTANT VOLTS MODE

In the constant volts mode, the Dynaload acts as an adjustable power zener diode. The regulating voltage is programmable from approximately 3-50V by the front panel volts adjust control. The constant volts position is used to simulate a battery to a battery charger, or the Dynaload may also be used as a shunt regulator for special applications.

3.6 POWER RATING

The Model DLVP 50-300-3000 will dissipate 3000W continuously. In order to assure that overheating does not occur, the sides and rear of the Dynaload should be clear for the air intake and the air exhaust. The cooling air enters from the sides and leaves from the rear. The Dynaload should periodically be checked for dust accumulation. If the power devices should exceed 125° C, a thermal cutout will trip the circuit breaker.

3.7 PROTECTIVE CIRCUITS

The Dynaload has internal current limiting at approximately 320A maximum, at which point the power limit lamp is lit, and if the load current exceeds approximately 340A, the circuit breaker will trip. The Dynaload also incorporates reverse voltage protection by reverse diode. If the input is hooked up backwards, the source will be shorted. In the event that an overvoltage is applied to the Dynaload, an internal overvoltage circuit will open the circuit breaker, thereby protecting all internal circuits.

The voltage current product is also monitored to prevent an overpower condition from happening. Accordingly, the current limit characteristic are set at approximately 320A, which is maintained to approximately 11V. At this point, the current limit characteristic is reduced as the input voltage is increased, thereby limiting the maximum power which may be programmed into the Dynaload. When the load exceeds 320A or 3200W, the power limit indicator will be lit.

3.8 SPECIAL APPLICATIONS

The Dynaload may be used for AC load testing, within its ratings, by the use of an external bridge rectifier so that the Dynaload sees pulsating DC, but the AC source sees an AC load. The effect of the rectifier is to slightly distort the Dynaload characteristics at low voltages and currents. The Dynaload is not normally recommended for testing AC sources above 1000 cycles due to its limited speed of response, unless the user specifically recognizes the load characteristics at higher frequencies.

The Dynaload may also be used as a current or voltage regulator rather than a load for special applications as described in Sections 3.2 and 3.5.

3.9 EFFECTS OF CABLE INDUCTANCE ON PULSE LOADING

When the Dynaload is used for high current pulse loading, the effects of cable inductance must be considered The critical parameters are the 50 microsecond rise time and the 3V minimum compliance specifications. If the inductance of the cables from the voltage source is great enough to cause the voltage at the Dynaload to go below 3V, then excessive current wave form distortion will occur. This is because the power devices are driven into saturation in an attempt to reach the programmed current which cannot occur because of the low connector voltage. Once in a saturated state, the response time is much slower. The result is a significant overshoot on the rising edge of the pulse. The peak reading ammeter will measure this peak and give deceiving results.

In order to prevent this from occuring, it should be noted that:

1. 1 microhenry = 2.4 feet of wire (total).
2. 50A @ 50 microseconds rise time = 1 volt drop with 1 microhenry.
3. The inductive drop cannot exceed the difference between the source voltage and the 3V compliance.

For example: To test a 10V source with a 100A pulse, the maximum cable length would be:

E Max drop = 7V

$$E = L \frac{di}{dt} \qquad 7V = L \frac{100A}{50us}$$

L = 3.5 microhenries maximum

Maximum cable length = 8.4 feet total
or 4.2 feet from source to Dynaload.

If the distance from the load to the source must be greater than this, there are several methods to increase the maximum distance. One way is to use several insulated conductors. This cuts the inductance in half if 4 are used instead of 2, or by one-third if 6 are used. This doubles or triples the maximum length, respectively. Another method is to slow down the rise time of the pulse generator before applying it to the regulation loop. This can be done by removing the jumper on TB1 and inserting an R-C network between the pulse-out and pulse-in terminals. Increasing the rise time to 100 microseconds will double the maximum cable length. The third method is to use a large electrolytic capacitor at the dynaload studs that can supply the current necessary to conteract the inductive drop of the cable. If the previous example required 15 feet of total cable length or 6.25 microhenries, which would be 12.5V of inductive drop, then the capacitor would have to supply 5.5V @ 100A for 50 microsencond. By the formula:

$$E = \frac{I \quad T}{C}$$

The capacitor required would be 900 microfarads.

4.0 CALIBRATION PROCEDURES

4.1 VOLTMETER CALIBRATE

NO LOAD CURRENT, CIRCUIT BREAKER CLOSED

6V RANGE;	SET	3V.	(2.94 - 3.06V)	R37
18V RANGE;	SET	9V.	(8.82 - 9.18V)	R38
60V RANGE;	SET	30V.	(29.4 - 30.6V)	R39

4.2 AMMETER CALIBRATE

PEAK-AVG SWITCH IN AVG POSITION

36A RANGE;	SET	30A.	(29.4 - 30.6A)	R40
* CHECK @ 6A READING.			(5.88 - 6.12A)	
120A RANGE;	SET	100A.	(98 - 102A)	R41
360A RANGE;	SET	300A.	(294 - 306A)	R42
* ADJUST R77 IF NECESSARY.				

4.3 CURRENT CALIBRATE SAMPLE

SET @ 20MV WITH 100A LOAD. (R64)

4.4 AMPS PER VOLT CALIBRATE

APPLY 4V TO UNIT: MEASURE VOLTAGE WITH DIGITAL AT INPUT STUDS. WITH COARSE LOAD, ADJUST FULL CLOCKWISE.

0-20 A/V RANGE;	SET 80A.	(79.2 - 80.8A)	R35
0-60 A/V RANGE;	SET 240A.	(238 - 242A)	R36

4.5 CONSTANT CURRENT CALIBRATE

WITH COURSE LOAD, ADJUST FULL CLOCKWISE, 10V APPLIED TO UNIT.

0-60A RANGE	(59.5 - 60.5A)	R33
0-300A RANGE	(297.5 - 302.5A)	R34

4.6 CURRENT LIMIT CALIBRATE

SET C. L. at 10V. (300 - 325A) R85

4.7 POWER LIMIT CALIBRATE

SET P. L. (68 - 78A) AT 45V. R94

SET P. L. (86 - 100A) AT 35V. R94

SET P. L. (120 - 140A) AT 25V. R94

Check power limit indicator.

4.8 LINEARITY CALIBRATE

A 0-10V power supply with high resolution of adjustment will be required to accurately set the program voltage. The program voltage is applied to the external modulation pin at TB1-3. The calibration should be done with a 10V source voltage.

PROGRAM VOLTAGE	LOAD CURRENT
0.5V	________ (14.7A - 15.3A)
1.0V	________ (29.4A - 30.6A)
4.0V	________ (117.6A - 122.4A)
7.0V	________ (205.8A - 214.2A)
10.0V	________ (294.0A - 306.0A)

NOTE

R67 IS USED TO ADJUST LOW CURRENT SET, AND R32 IS USED TO ADJUST HIGH CURRENT.

5.0 THEORY OF OPERATION

5.1 CIRCUITS REGULATOR LOOP

Operation amplifiers U3 and U4 process a voltage that is derived from either the reference for constant current or from the source voltage in the amps per volt mode. Operational amplifier U5 is used as an error amplifier that compares the processed voltage from U3, U4 and the voltage drop generated on SH101 from the load current. The output of U5 is sent through a current gain stage (Q2) and then directly to the power transistors to control the load current. The power transistor section consists of 7 drivers and 71 main transistors. Each main transistor has an emmiter resistor that allows equal current sharing. The emitter resistors are of the fusible type such that the failure of any one transistor will cause the resistor to open and that transistor will be isolated from the bank by the individual base steering diodes.

A voltage is applied through R17 and/or R31 to Pin 2 (inverting input) of U3 that is determined by the front panel load adjust controls. If the DC load adjust is adjusted for 300A, then +0.6V will be present on D4 and R17. Pin 2 of U3 is a virtual null and should not be measured. The output of U3 will be -0.9V and is sent through R46 to U4, Pin 2. The output of U4 will be +0.2V and is applied to Pin 3 (non-inverting) of U5. This is now the reference voltage for comparison with the shunt voltage. The shunt voltage is applied to Pin 2 of U5 through R65. Error amplifier U5 will control the loop to maintain equal voltages on Pins 2 and 3.

If the processed reference voltage on pin 3 of U5 is greater than the shunt voltage, then the output on Pin 6 will drive Q2 harder, which will in turn increase the drive current to the power transistor configuration. This will increase the load current from the source until the shunt voltage reaches the reference voltage, at which point the error amplifier will reduce the drive, and the loop will equalize in regulatory fashion.

The RC networks around U5 determine the speed of response of U5 and are made to be slower then the sum of the other components in the loop to assure that U5 is the controlling factor. The response time of the loop is approximately 50 us for a 0-300A step.

Potentiometer R67 is used to balance the input section of U5 and to compensate for ground potential differences from shunt to the PCB. This control is used to calibrate the linearity in the external program mode.

Transistor Q3 is used to actively shut down the power section if the shunt voltage should exceed that programmed and therefore, improves the fall time during high current pulse loading.

5.2 PEAK READING AMMETER

The basic principle involved in the peak reading ammeter circuit is to charge a capacitor to a value proportional to the peak voltage developed across the shunt. The voltage must not decay more than 2% between successive pulses. This is accomplished by operational amplifiers U6 and U7.

N O T E

THE VOLTAGE GAIN OF AN OPERATIONAL AMPLIFIER IS DIRECTLY PROPORTIONAL TO THE RATIO OF INPUT CURRENT TO FEEDBACK CURRENT. THREE CONFIGURATIONS ARE USED IN THE UNIT.

THE INVERTING AMPLIFIER, WHERE THE INPUT IS TO PIN 2, HAS A VOLTAGE GAIN EQUAL TO THE FEEDBACK RESISTOR FROM PIN 6, DIVIDED BY THE INPUT RESISTOR TO PIN 2. IN THIS CONFIGURATION, THE QUIESCENT OUTPUT VOLTAGE IS EQUAL TO THE VOLTAGE ON PIN 3.

THE VOLTAGE FOLLOWER, WHERE THE INPUT IS TO PIN 3, HAS UNITY GAIN IF PIN 2 IS CONNECTED TO THE OUTPUT ONLY.

THE COMPARATOR OR ERROR AMPLIFIER CONFIGURATION WILL COMPARE THE VOLTAGES PRESENT ON PIN 2 AND 3, AND THE OUTPUT WILL BE HIGH IF PIN 3 IS GREATER, OR LOW IF PIN 2 IS GREATER.

The input amplifier of the peak reading ammeter U7. The circuit consists of an inverting amplifier (U7), a storage capacitor (C9), and a high impedance voltage follower (U6). The gain of the circuit is determined by the input resistor selected by the ammeter range switches and an overall feedback resistor R56.

As a voltage pulse is impressed on the shunt by a current pulse, U7 amplifies and inverts the signal to -5V peak for a full scale resding. Transistors Q4 and Q5 supply the current required to instantaneously pull capacitor C9 to this -5V potential. Capacitor C9 is now charged to a voltage proportional to the peak of the load current wave form. Voltage follower U6 transfers this voltage to the ammeter through R74 without loading down C9. Potentiometer R77 is used to zero the ammeter. The peak average switch S4 is out of the circuit for peak reading and shorts out CR9 for average reading. Shorting CR9 causes R71 to load down C9, and therefore, the pulse current is not stored. The ammeter sees the pulse current waveform and will give a mechanically averaged reading.

5.3 CURRENT LIMIT/POWER LIMIT

Operational amplifier U8 performs the function of current limit and power limit by comparing a reference set by R85 to a combination of the shunt voltage and input source voltage. If the source voltage is below 11V, then the comparison is just reference to shunt voltage. When the shunt voltage exceeds the value set by R85, the output of U8 will go negative and shut down the drive to the power transistors through the power limit indicator and R62. When the product of source voltage and shunt voltage exceeds 3000W, the drive will similarly by limited. This is accomplished by zener diodes, VR7 and VR10. A portion of the source voltage is added to the shunt voltage by VR7 and VR10, such that, as the source voltage increases, the current limit point is reduced. The power limit curve is a dual slope approximation.

5.4 ELECTRONIC CIRCUIT BREAKER

A J-K flip-flop (U9) is used to energize a power contractor through Q8. The front panel DC load-on switch is a momentary contact type that grounds Pin 12 of U9 to change the state of the flip-flop. The set input (Pin 13), reset (pin 2), and output (pins 8, 9) are brought out to TB2-1 for remote control and status. The current limit section (U8) is directly connected to the reset input and will override any other control in the event of an overcurrent, over-voltage, or over-power condition.

5.5 OVERVOLTAGE PROTECTION

Operational amplifier U8 also provides overvoltage protection through the use of R89, VR8, and VR9. If the source voltage exceeds 50V, these zener diodes will cause the voltage on Pin 2 to rise rapidly and put the loop into power limit. The circuit breaker will trip because of the connection from U8 to the reset input of U9.

5.6 PULSE GENERATOR

Integrated circuit U1 (A3) is a variable pulse width oscillator whose frequency is determined by the value of capacitance from Pin 7 to ground. The pulse width is determined by the DC reference voltage present at pin 2. Pin 10 is a 5V reference. The output of the oscillator (pins 12, 13) is inverted by Q2 (A3) and sent to the pulse load adjust controls. Transistor Q1 on A3 is used to generate a spike from the pulse generators output for triggering an oscilloscope.

5.7 SHORT CIRCUIT

Short circuit loading is initiated by momentary push button S3. With S3 in the short circuit position, Q6 turns on. With Q6 conducting, Q7 and Q11 are turned on, completing circuits to the short circuit contactor (K3) coil and the SCR101 gate. Since the speed of the Q11-SCR101 combination is much faster than the Q7-Contactor combination (10 ms), the SCR takes the surge current. This avoids damage to the contactor's contacts.

With the contactor closed, the voltage across the SCR is less than the voltage required to shut the SCR off. In this way, under steady state short circuit conditions, the full current is taken by the contactor.

When S3 is released, transistors Q6, Q7, and Q11 turn off. Once again the Q11-SCR101 combination is much faster than the Q7-K3 combination (50 ms). This ensures that the SCR101 gate is low before the contactor opens, thus removing the short circuit condition.

5.8 POWER SUPPLY CIRCUITRY

Power is applied through F1 and S1 to the two fans and the primary of T101. The two primaries of T101 may be connected in parallel for 115 VAC, or in series for 230V operation. Secondary 8, 9, 10 is rectified and filtered both positive and negative. Three pin regulators U1 and U2 regulate the raw DC to ±12V for all of the operational amplifiers and mode indicator lamps. Secondary 5, 6, 7 is rectified and filtered to 28V for the short circuit and circuit breaker contactors.

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED
A		Added C25, R101, and R102 to A2.	12/21/78	WJMc
B		Revised and released for production.	6/20/79	WJMc
C		Corrected U1, U2 P/N's; retyped page 2 for clarity.	7/11/79	WJMc
D		Added CR179-CR185, Q179-Q185; former R179 changed to R186; added R179-R185 and R179A-R185A. Q150 was 2N3055; Q160 and Q172 were NOT USED.	9/20/79	WJMc
E		R101-R135 were .1, 3W or 5W; also R137 thru R178, unless NOT USED.	9/20/79	WJMc
F		(A2) C7 was .00022; C8 was .047; C22 was .0047; C23 was .01; R17 was 10K, CCH; R27 was 274; R33 was 10K; R35 was 10K; R44, 45, 46, 47 were 10%; R49 was 6.8K; R60 was 12K, RLR; VR8 and 9 were 1N967B. (A3) R7 was 1K. (Chassis) Added C28 and C29. With Serial No. 12: C3 (A3) was .47; C7 (A3) was .0015; added R106 (A2). ECN 11079	10/3/79	WJMc
G		J3 was A2139-6.	10/31/79	[signature]
H		P3 was (7) PIN; added J8, P8, and pins; ADDED C32 TO CHASSIS ASSY; ADDED C29-C31 & C28A-C31A TO TOP & BOTTOM HEATSINK ASSY ECN 11094	12/7/79	[signature]
J		S4 was TT13A-4T¾. R3 and R3A were B106971. Handles were NP-15, Vemaline.	6/6/80	[signature]
K		Added C9 to A3 board B105897. ECN 11168	10/8/80	[signature]
L		Added CR20, R107-R110, and VR11. Added page 5A.	11/21/80	BK
M		R100 was 100Ω	2-13-81	[signature]
N		Chassis: Added R190 and R191. ECN 11847	6/16/82	[signature]

ON	ISSUE
WN . Schlager	DATE 12/6/78
KED WJMc	DATE 10-3-79
WJMc	DATE 10-3-79

Transistor Devices Inc.
Cedar Knolls, New Jersey

ELECTRICAL PARTS LIST

DLVP 50-300-3000A

CODE IDENT NO.	SIZE	
09004	A	105774

SHEET

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED
P		Chassis Assy: Updated P/N's, S1 was 881-2181-01A-7A1H; S2 was 881-1181-03A-7387.	25MAY83	R
R		A3 PCB: C4 WAS .068 MFD, 250V. ECN 12500	29MAY84	R
S		A2 PCB ASSY: U8 P/N was CA741E. VR6 P/N was 1N752A. ECN 12655	9/26/84	R
T		A3 PCB ASSY: C3 WAS .1 MFD, 250V; C7 WAS .0022 MFD, 250V; R7 WAS 820. ECN 12985	5-21-85	
U		A2 PCB: R18, R20, R22 WERE 15.4K, 1/2W, 1%; R19 WAS 78.7K, 1/2W, 1%; R23 WAS 4.87K, 1/2W, 1%; R28 WAS 464, 1/2W, 1%; R60 WAS 16.9K, 1/2W, 1%; R40 WAS 500 POT, R41 WAS 1K POT, R42 WAS 2K POT. CHASSIS: SH101 WAS A105798. MODEL NO. WAS DLVP 50-300-3000. ECN 13021	6-4-85	
V		R 190 and R191 were 39Ω, 5W, 10%; K1 and K2 were 24V, 70-903. ECN 13435	2-26-86	
W		Added C33 to A2 PCB. ECN-11649 KAS	8-20-86	R
Y		A2 PCB ASSY: R104 was RES. 120, P/N RW79U1200F. ECN-13838 KAS	5JAN87	

ISSUE	
DATE	
DATE	
DATE	

Transistor Devices Inc.
Cedar Knolls, New Jersey

ELECTRICAL PARTS LIST

DLVP 50-300-3000A

CODE IDENT NO.	SIZE	
09004	A	105774

TY QD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
		A1 PCB Assembly (D105893)--PCB: D105891		
	S4	SWITCH	TT11DG-YRA-1	ALCO SWITCH
	S5	SWITCH	B106872-1	TDI
	S6	SWITCH	B106872-1	TDI
	S7	SWITCH	B106872-2	TDI
	P2A	CONNECTOR (8) PIN	A2402-8B	MOLEX
	P2B	CONNECTOR (6) PIN	A2402-6B	MOLEX
	P2C	CONNECTOR (8) PIN	A2402-8B	MOLEX
	P2D	CONNECTOR (9) PIN	A2402-9B	MOLEX
	P5	CONNECTOR (8) PIN	A2402-8B	MOLEX
	P6	CONNECTOR (6) PIN	A2402-6B	MOLEX
		A2 PCB Assembly (D105896)--PCB: D105894		
	C1	CAP. 470 MFD, 40V	ET471X040A02	MEPCO ELECTRA
	C2	CAP. 470 MFD, 40V	ET471X040A02	MEPCO ELECTRA
	C3	CAP. 470 MFD, 40V	ET471X040A02	MEPCO ELECTRA
	C4	CAP. 10 MFD, 25V	ET100X025A2	MEPCO ELECTRA
	C5	CAP. 10 MFD, 25V	ET100X025A2	MEPCO ELECTRA
	C6	CAP. 3.3 MFD, 25V	ET3P3X025A1	MEPCO ELECTRA
	C7	CAP. .0022 MFD, 250V	C280AE/A2K2	MEPCO ELECTRA
	C8	CAP. .0047 MFD, 250V	C280AE/A4K7	MEPCO ELECTRA
	C9	CAP. .01 MFD, 200V	CK06BX103K	QPL
	C10	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C11	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C12	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C13	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C14	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C15	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C16	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C17	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C18	CAP. .001 MFD, 250V	C280AE/A1K	MEPCO ELECTRA
	C19	CAP. 10 MFD, 25V	ET100X025A2	MEPCO ELECTRA
	C20	CAP. .047 MFD, 250V	C280AE/A47K	MEPCO ELECTRA
	C21	CAP. .047 MFD, 250V	C280AE/A47K	MEPCO ELECTRA
	C22	CAP. .047 MFD, 250V	C280AE/A47K	MEPCO ELECTRA
	C23	CAP. .001 MFD, 250V	C280AE/A1K	MEPCO ELECTRA
	C24	CAP. 2.2 MFD, 63V	ET2P2X063A3	MEPCO ELECTRA
	C25	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C26	CAP. .47 MFD, 250V	C280AE/A470K	MEPCO ELECTRA
	C27	CAP. .47 MFD, 250V	C280AE/A470K	MEPCO ELECTRA
	C28	CAP. .0047 MFD, 250V	C280AE/A4K7	MEPCO ELECTRA
	CR1	RECTIFIER	A15A	GE
	CR2	RECTIFIER	A15A	GE
	CR3	RECTIFIER	1N645	QPL
	CR4	RECTIFIER	1N645	QPL
	CR5	RECTIFIER	1N645	QPL

QTY REQD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	CR6	RECTIFIER	1N645	QPL
	CR7	RECTIFIER	1N645	QPL
	CR8	RECTIFIER	NOT USED	
	CR9	RECTIFIER	1N4148	QPL
	CR10	RECTIFIER	1N645	QPL
	CR11	RECTIFIER	1N4245	QPL
	CR12	RECTIFIER	1N645	QPL
	CR13	RECTIFIER	NOT USED	QPL
	CR14	RECTIFIER	NOT USED	QPL
	CR15	RECTIFIER	1N645	QPL
	CR16	RECTIFIER	1N645	QPL
	CR17	RECTIFIER	1N645	QPL
	CR18	RECTIFIER	1N645	QPL
	CR19	RECTIFIER	1N645	QPL
	CR20	RECTIFIER	NOT USED	
	Q1	TRANSISTOR	NOT USED	
	Q2	TRANSISTOR	2N3054	QPL
	Q3	TRANSISTOR	2N2907A	QPL
	Q4	TRANSISTOR	2N2907A	QPL
	Q5	TRANSISTOR	2N2219A	QPL
	Q6	TRANSISTOR	2N2907A	QPL
	Q7	TRANSISTOR	2N3054	QPL
	Q8	TRANSISTOR	2N3054	QPL
	Q9	TRANSISTOR	2N2219A	QPL
	Q10	TRANSISTOR	2N2222	QPL
	Q11	TRANSISTOR	2N2219A	QPL
	R1	RES. 10, ½W, 10%	RCR20G100KS	QPL
	R2	RES. 1.2K, 1W, 10%	RCR32G122KS	QPL
	R3	RES. 3.3K, ½W, 2%	RLR20C3301GR	QPL
	R4	RES. POT, 1K	101SX	DALE
	R5	RES. POT, 1K	101SX	DALE
	R6	RES. 3.3K, ½W, 2%	RLR20C3301GR	QPL
	R7	RES. 220, ½W, 2%	RLR20C2200GR	QPL
	R8	RES. 220, ½W, 2%	RLR20C2200GR	QPL
	R9	RES. 470, ½W, 10%	RCR20G471KS	QPL
	R10	RES. 4.7K, ½W, 10%	RCR20G472KS	QPL
	R11	RES. 10, ½W, 10%	RCR20G100KS	QPL
	R12	RES. 680, ½W, 10%	RCR20G681KS	QPL
	R13	RES. 680, ½W, 10%	RCR20G681KS	QPL
	R14	RES. 680, ½W, 10%	RCR20G681KS	QPL
	R15	RES. 470, ½W, 2%	RLR20C4700GR	QPL
	R16	RES. 1.27K, ½W, 1%	CCH1271F	A-B
	R17	RES. 16.9K, 1/4W, 1%	RN55C1692F	QPL
	R18	RES. 27.4K, 1/4W, 1%	RN55C2742F	
	R19	RES. 154K, 1/4W, 1%	RN55C1543F	
	R20	RES. 33.2K, 1/4W, 1%	RN55C3322F	
	R21	RES. 2.26K, ½W, 1%	CCH2261F	A-B
	R22	RES. 40.2K, 1/4W, 1%	RN55C4022F	
	R23	RES. 15.4K, 1/4W, 1%	RN55C1542F	

item - see source control or specification control drawing TRANSISTOR DEVICES INC. CEDAR KNOLLS, N.J.

DLVP 50-300-3000A

CODE IDENT NO	SIZE		
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QTY REQD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	R24	RES. 5.62K, ½W, 1%	CCH5621F	A-B
	R25	RES. 15.4K, ½W, 1%	CCH1542F	A-B
	R26	RES. 56.2K, ½W, 1%	CCH5622F	A-B
	R27	RES. 100, 1/4W, 1%	RN55C100 0F	
	R28	RES. 332, 1/4W, 1%	RN55C3320F	
	R29	RES. 1K, ½W, 1%	CCH1001F	A-B
	R30	RES. 270, ½W, 10%	RCR20G271KS	QPL
	R31	RES. 15.4K, ½W, 1%	CCH1542F	A-B
	R32	RES. POT, 5K, ½W, 10%	101SX	DALE
	R33	RES. POT, 50K, ½W, 10%	101SX	DALE
	R34	RES. POT, 5K, ½W, 10%	101SX	DALE
	R35	RES. POT, 20K, ½W, 10%	101SX	DALE
	R36	RES. POT, 5K, ½W, 10%	101SX	DALE
	R37	RES. POT, 1K, ½W, 10%	101SX	DALE
	R38	RES. POT, 5K, ½W, 10%	101SX	DALE
	R39	RES. POT, 10K, ½W, 10%	101SX	DALE
	R40	RES. POT, 100, 10%	3386X-101	BOURNS
	R41	RES. POT, 200, 10%	3386X-201	BOURNS
	R42	RES. POT, 1K, 10%	3386X-102	BOURNS
	R43	RES. 680, ½W, 10%	RCR20G681KS	QPL
	R44	RES. 4.7K, ½W, 2%	RLR20C4701GR	QPL
	R45	RES. 4.7K, ½W, 2%	RLR20C4701GR	QPL
	R46	RES. 22K, ½W, 2%	RLR20C2202GR	QPL
	R47	RES. 4.7K, ½W, 2%	RLR20C4701GR	QPL
	R48	RES. 1.5K, ½W, 10%	RCR20G152KS	QPL
	R49	RES. 10K, ½W, 10%	RCR20G103KS	QPL
	R50	RES. 100, ½W, 10%	RCR20G101KS	QPL
	R51	RES.	NOT USED	
	R52	RES. 470, ½W, 10%	RCR20G471KS	QPL
	R53	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R54	RES. 1.5K, ½W, 10%	RCR20G152KS	QPL
	R55	RES. 2.2K, ½W, 10%	RCR20G222KS	QPL
	R56	RES. 68K, ½W, 2%	RLR20C6802GR	QPL
	R57	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R58	RES. 10K, ½W, 10%	RCR20G103KS	QPL
	R59	RES. 330, ½W, 10%	RCR20G331KS	QPL
	R60	RES. 33.2K, 1/4W, 1%	RN55C3322F	QPL
	R61	RES. 470, ½W, 10%	RCR20G471KS	QPL
	R62	RES. 330, ½W, 10%	RCR20G331KS	QPL
	R63	RES. 470, ½W, 10%	RCR20G471KS	QPL
	R64	RES. POT, 200, ½W, 10%	101SX	DALE
	R65	RES. 100, ½W, 10%	RCR20G101KS	QPL
	R66	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R67	RES. POT, 5K, ½W, 10%	101SX	DALE
	R68	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R69	RES. 4.7K, ½W, 10%	RCR20G472KS	QPL
	R70	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R71	RES. 1K, ½W, 10%	RCR20G103KS	QPL
	R72	RES. 10, ½W, 10%	RCR20G100KS	QPL
	R73	RES. 1K, ½W, 10%	RCR20G102KS	QPL

r item - see source control or specification control drawing TRANSISTOR DEVICES INC. CEDAR KNOLLS, N.J.

	CODE IDENT NO	SIZE		
DLVP 50-300-3000A	09004	A	PL	105774
	SCALE			SHEET 4 of 13

Y D	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	R74	RES. 4.7K, ½W, 2%	RLR20C4701GR	QPL
	R75	RES. 2.7K, ½W, 2%	RLR20C2701GR	QPL
	R76	RES. 2.7K, ½W, 2%	RLR20C2701GR	QPL
	R77	RES. POT, 5K, ½W, 10%	101SX	DALE
	R78	RES. 2.7K, ½W, 2%	RLR20C2701GR	QPL
	R79	RES. 270, ½W, 10%	RCR20G271KS	QPL
	R80	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R81	RES. 220, ½W, 10%	RCR20G221KS	QPL
	R82	RES. 3.3K, ½W, 10%	RCR20G332KS	QPL
	R83	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R84	RES. 5.6K, ½W, 2%	RLR20C5601GR	QPL
	R85	RES. POT, 500, ½W, 10%	101SX	DALE
	R86	RES. 10K, ½W, 10%	RCR20G103KS	QPL
	R87	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R88	RES. 10K, ½W, 10%	RCR20G103KS	QPL
	R89	RES. POT, 5K, ½W, 10%	101SX	DALE
	R90	RES. 2.7K, ½W, 10%	RCR20G272KS	QPL
	R91	RES. 22K, ½W, 10%	RCR20G223KS	QPL
	R92	RES. 390, ½W, 10%	RCR20G391KS	QPL
	R93	RES. 1.8K, ½W, 10%	RCR20G182KS	QPL
	R94	RES. POT, 200, ½W, 10%	101SX	DALE
	R95	RES. 12K, ½W, 10%	RCR20G123KS	QPL
	R96	RES. 470, ½W, 10%	RCR20G471KS	QPL
	R97	RES. 3.3K, ½W, 10%	RCR20G332KS	QPL
	R98	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R99	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R100	RES. 1K, ½W, 10%	RCR20G102KS	QPL
	R101	RES. 10 MEG, ½W, 10%	RCR07G106KS	QPL
	R102	RES. 10K, ¼W, 10%	RCR07G103KS	QPL
	R103	RES. 10K, ¼W, 10%	RCR07G103KS	QPL
	R104	RES. 121 , 3W, WW, 1%	RW79U1210F	QPL
	R105	RES. 1K, ¼W, 10%	RCR07G102KS	DALE
	R106	RES. 100K, ½W, 10%	RCR20G104KS	QPL
	U1	I. C.	MC7808C or UA7808C	MOTOROLA or FAIRCHILD
	U2	I. C.	MC7908C or UA7908C	MOTOROLA or FAIRCHILD
	U3 THRU U7	I. C.	CA3140E	RCA
	U8	I. C.	LM741CN	RCA
	U9	I. C.	SN7472	SIGNETICS
See page 5A following this page.				
	VR1	DIODE	1N5350	QPL
	VR2	DIODE	1N5350	QPL
	VR3	DIODE	NOT USED	
	VR4	DIODE	1N821	QPL
	VR5	DIODE	1N758A	QPL
	VR6	DIODE	1N753B	QPL
	VR7	DIODE	1N757	QPL
	VR8	DIODE	1N969B	QPL
	VR9	DIODE	1N969B	QPL
	VR10	DIODE	1N963B	QPL

QTY REQD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	R107	RES.	NOT USED	
	R108	RES.	NOT USED	
	R109	RES.	JUMPER	
	R110	RES.	NOT USED	
	VR11	DIODE	NOT USED	
	C33	CAP.	NOT USED	

r item - see source control or specification control drawing TRANSISTOR DEVICES INC. CEDAR KNOLLS, N.J.

LVP 50-300-3000A

CODE IDENT NO	SIZE		
09004	A	PL	105774
SCALE		SHEET 5A of 13	

QTY REQD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	P1	CONNECTOR (6) PIN	A2402-6B	MOLEX
	J2A	CONNECTOR (8) PIN	A-2145-8A	MOLEX
	J2B	CONNECTOR (6) PIN	A-2145-6A	MOLEX
	J2C	CONNECTOR (8) PIN	A-2145-8A	MOLEX
	J2D	CONNECTOR (9) PIN	A-2145-9A	MOLEX
	P3	CONNECTOR (8) PIN	A2402-8B	MOLEX
	P4	CONNECTOR (16) PIN	A2402-16B	MOLEX
		A3 PCB ASSEMBLY (B105893)--PCB: B105897		
	C1	CAP. .047 MFD, 250V	C280AE/A47K	MEPCO ELECTRA
	C2	CAP. .001 MFD, 250V	C280AE/A1K	MEPCO ELECTRA
	C3	CAP. .47MFD, 50V	CK06BX474K	MEPCO ELECTRA
	C4	CAP. 0.1 MFD, 250V	713A1BB104PK251S	MEPCO ELECTRA
	C5	CAP. .068 MFD, 250V	C280AE/A68K	MEPCO ELECTRA
	C6	CAP. .022 MFD, 250V	C280AE/A22K	MEPCO ELECTRA
	C7	CAP. .0015 MFD, 250V	C280AE/A1K5	MEPCO ELECTRA
	C8	CAP. .0022 MFD, 250V	C280AE/A2K2	MEPCO ELECTRA
	C9	CAP. .0022 MFD, 250V	C280AE/A2K2	MEPCO ELECTRA
	CR1	RECTIFIER	1N645	QPL
	CR2	RECTIFIER	1N645	QPL
	Q1	TRANSISTOR	2N2219A	QPL
	Q2	TRANSISTOR	2N2907A	QPL
	R1	RES. 2.7K, ½W, 10%	RCR20G272KS	QPL
	R2	RES. 10K, ½W, 10%	RCR20G103KS	QPL
	R3	RES. 100, ½W, 10%	RCR20G101KS	QPL
	R4	RES. 10K, ½W, 10%	RCR20G103KS	QPL
	R5	RES. 10K, ½W, 10%	RCR20G103KS	QPL
	R6	RES. 1K, ½W, 2%	RLR20C1001GR	QPL
	R7	RES. 1K, ½W, 2%	RLR20C1001GR	QPL
	R8	RES. 270K, ½W, 2%	RLR20C8200GR	QPL
	R9	RES. 27K, ½W, 10%	RCR20G273KS	QPL
	R10	RES. 47K, ½W, 10%	RCR20G473KS	QPL
	S8	SWITCH	65031K-206-A (3 P.B.	SWITCHCRAFT
	U1	I. C.	SG3524P	SILICON GENERAL
	P7	CONNECTOR (8) PIN	A-2402-8B	MOLEX
		CHASSIS ASSEMBLY		
	B101	BLOWER	FEATHER (#113)	ROTRON
	C32	CAP .0022MFD, 250V	C280AE/A2K2	MEPCO ELECTRA
	C26	CAP. .47 MFD, 250V	C280AE/A470K	MEPCO ELECTRA
	C27	CAP. .47 MFD, 250V	C280AE/A470K	MEPCO ELECTRA
	C101	CAP. 2000 MFD, 16V	WBR2000-16	QPL
	C102	CAP. 3.3MFD, 25V	ET3P3X025A1	MEPCO ELECTRA

QTY REQD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	CR110	RECTIFIER	A15A	GE
	CR130	RECTIFIER	A15A	GE
	CR148	RECTIFIER	1N1184	QPL
	CR136	"	A15A	GE
	CR137	"	A15A	GE
	DS1	LAMP, L. E. D.	5082-4850	HEWLETT-PACKARD
	DS2	LAMP, L. E. D.	5082-4850	HEWLETT-PACKARD
	DS3	LAMP, L. E. D.	5082-4850	HEWLETT-PACKARD
	DS4	LAMP, L. E. D.	5082-4850	HEWLETT-PACKARD
	F1	FUSE, 1ASB	MDL-1	BUSSMANN
	XF1	FUSEHOLDER	HTA	BUSSMANN
	K1	36 RELAY (N.O.)	586-906	STANCOR
	K2	36 RELAY (N.O.)	586-906	STANCOR
	K3	24 RELAY (N.O.)	70-903	STANCOR
	J1	CONNECTOR PLUG	A2139-6	MOLEX
	J3	CONNECTOR PLUG	A2139-8	MOLEX
	J4	CONNECTOR PLUG	A2139-16	MOLEX
	J5	CONNECTOR PLUG	A2139-8	MOLEX
	J6	CONNECTOR PLUG	A2139-6	MOLEX
	J7	CONNECTOR	A2139-8	MOLEX
	M1	METER (VOLTS)	A105712 (Beede Type 3-02)	TDI
	M2	METER (AMPS)	A105712 (Beede Type 3-02)	TDI
	Q136	TRANSISTOR	2N5039	QPL
	R1	RES. POT, 500K, ½W, 10%	> B100226	TDI/CLAROSTAT
	R1A	RES. POT, 2.5K, ½W, 10%		
	R2	RES. POT, 250, ½W, 10%	> B100225	TDI/CLAROSTAT
	R2A	RES. POT, 2.5K, ½W, 10%		
	R3	RES. POT, 250, ½W, 10%	> B100225	TDI/CLAROSTAT
	R3A	RES. POT, 2.5K, ½W, 10%		
	R4	RES. POT, 10K, ½W, 10%	CM42808	CLAROSTAT
	R136A	RES. 47K, 1W, 10%	RCR32G473KS	QPL
(2)	R136	RES. 6.2, 3W, 5%	RW69V6R2	DALE
	S1	SWITCH SPST	881K21810PT01A70	COMPULITE
	S2	SWITCH SPST	881K11810PT03A13	COMPULITE
	S3	SWITCH N.O.	4001	GRAY HILL
	SCR101	SILICON CONT. RECT.	C45AX137-7326	GE
	SH101	SHUNT	B111683	TDI
	T101	TRANSFORMER	B105775	TDI
	TB1	TERMINAL BLOCK	670A-YSY-5	KULKA
	TB2	TERMINAL BLOCK	670A-YSY-5	KULKA

or item - see source control or specification control drawing TRANSISTOR DEVICES INC. CEDAR KNOLLS, N.J.

DLVP 50-300-3000A	CODE IDENT NO 09004	SIZE A	PL 105774
	SCALE		SHEET 7 of 13

QTY REQD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	TP1	TEST POINT	NOT USED	
	TP2	TEST POINT	NOT USED	
	TP3	TEST POINT, RED	1499-102	H. H. SMITH
	TP4	TEST POINT, BLACK	1499-103	H. H. SMITH
	TP5	TEST POINT, RED	1499-102	H. H. SMITH
2	---	HANDLES	A6171-7	UNICORP
	SJ-18-3	AC Line Cord	17406	Belden
		HEATSINK ASSEMBLY (TOP)	D105781	TDI
	C28	CAP .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C28A	CAP .047 MFD, 250V	C280AE/A47K	MEPCO ELECTRA
	C29	CAP .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
	C29A	CAP .047 MFD, 250V	C280AE/A47K	MEPCO ELECTRA
	CR101	RECTIFIER	IN645	QPL
	CR102	RECTIFIER	IN645	QPL
	CR103	RECTIFIER	IN645	QPL
	CR104	RECTIFIER	IN645	QPL
	CR105	RECTIFIER	IN645	QPL
	CR106	RECTIFIER	IN645	QPL
	CR107	RECTIFIER	IN645	QPL
	CR108	RECTIFIER	IN645	QPL
	CR109	RECTIFIER	IN645	QPL
	CR111	RECTIFIER	IN645	QPL
	CR112	RECTIFIER	IN645	QPL
	CR113	RECTIFIER	IN645	QPL
	CR114	RECTIFIER	IN645	QPL
	CR115	RECTIFIER	IN645	QPL
	CR116	RECTIFIER	IN645	QPL
	CR117	RECTIFIER	IN645	QPL
	CR118	RECTIFIER	IN645	QPL
	CR119	RECTIFIER	IN645	QPL
	CR120	RECTIFIER	IN645	QPL
	CR121	RECTIFIER	IN645	QPL
	CR122	RECTIFIER	IN645	QPL
	CR123	RECTIFIER	IN645	QPL
	CR124	RECTIFIER	IN645	QPL
	CR125	RECTIFIER	IN645	QPL
	CR126	RECTIFIER	IN645	QPL
	CR127	RECTIFIER	IN645	QPL
	CR128	RECTIFIER	IN645	QPL
	CR129	RECTIFIER	IN645	QPL
	CR131	RECTIFIER	IN645	QPL
	CR132	RECTIFIER	IN645	QPL

TY QD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	CR133	RECTIFIER	1N645	QPL
	CR134	RECTIFIER	1N645	QPL
	CR135	RECTIFIER	1N645	QPL
7	CR179 THRU CR185	RECTIFIER	1N645	QPL
	Q101 THRU Q109	TRANSISTOR	2N3055	QPL
	Q110	TRANSISTOR	2N5039	QPL
	Q111 THRU Q119	TRANSISTOR	2N3055	QPL
	Q120	TRANSISTOR	2N5039	QPL
	Q121 THRU Q129	TRANSISTOR	2N3055	QPL
	Q130	TRANSISTOR	2N5039	QPL
	Q131 THRU Q135	TRANSISTOR	2N3055	QPL
7	Q179-Q185	TRANSISTOR	2N3055	QPL
	R101 THRU R109	RES. .15, 5W, 10%	CP5	DALE
	R101A THRU R109A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
	R110	RES.	NOT USED	
	R110A	RES.	NOT USED	
	R111 THRU R119	RES. .15, 5W, 10%	CP5	DALE
	R111A THRU R119A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
	R120	RES. 100, ½W, 10%	RCR20G101KS	QPL

r item - see source control or specification control drawing **TRANSISTOR DEVICES INC. CEDAR KNOLLS, N.J.**

DLVP 50-300-3000A

CODE IDENT NO	SIZE		
09004	A	PL	105774

SCALE

QTY REQD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	R121 THRU R129	RES. .15, 5W, 10%	CP5	DALE
	R121A THRU R129A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
	R130	RES.	NOT USED	
	R130A	RES.	NOT USED	
	R131 THRU R135	RES. .15, 5W, 10%	CP5	DALE
	R186	RES. 470, ½W, 10%	RCR20G471KS	QPL
	R131A THRU R135A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
7	R179-R185	RES. .15, 5W, 10%	CP5	DALE
	TH101	THERMOSTAT, 125°C, N.C.	MODEL 2450 (TERM T-101)	ELMWOOD
	R179A THRU R185A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
		HEATSINK ASSEMBLY (BOTTOM) D105781		
	CR137 THRU CR147	RECTIFIER	1N645	QPL
	CR149	RECTIFIER	1N645	QPL
	CR150	RECTIFIER	NOT USED	
	CR151	RECTIFIER	1N645	QPL
	CR152	RECTIFIER	NOT USED	
	CR153 THRU CR159	RECTIFIER	1N645	QPL
	CR160	RECTIFIER	NOT USED	
	CR161	RECTIFIER	1N645	QPL
	CR162	RECTIFIER	NOT USED	
	CR163	RECTIFIER	1N645	QPL
	CR164	RECTIFIER	NOT USED	
	CR165 THRU CR171	RECTIFIER	1N645	QPL
	CR172	RECTIFIER	NOT USED	

Item - see source control or specification control drawing TRANSISTOR DEVICES INC. CEDAR KNOLLS, N.J.

	CODE IDENT NO	SIZE		
LVP 50-300-3000A	09004	A	PL	105774
	SCALE			SHEET 10 of 13

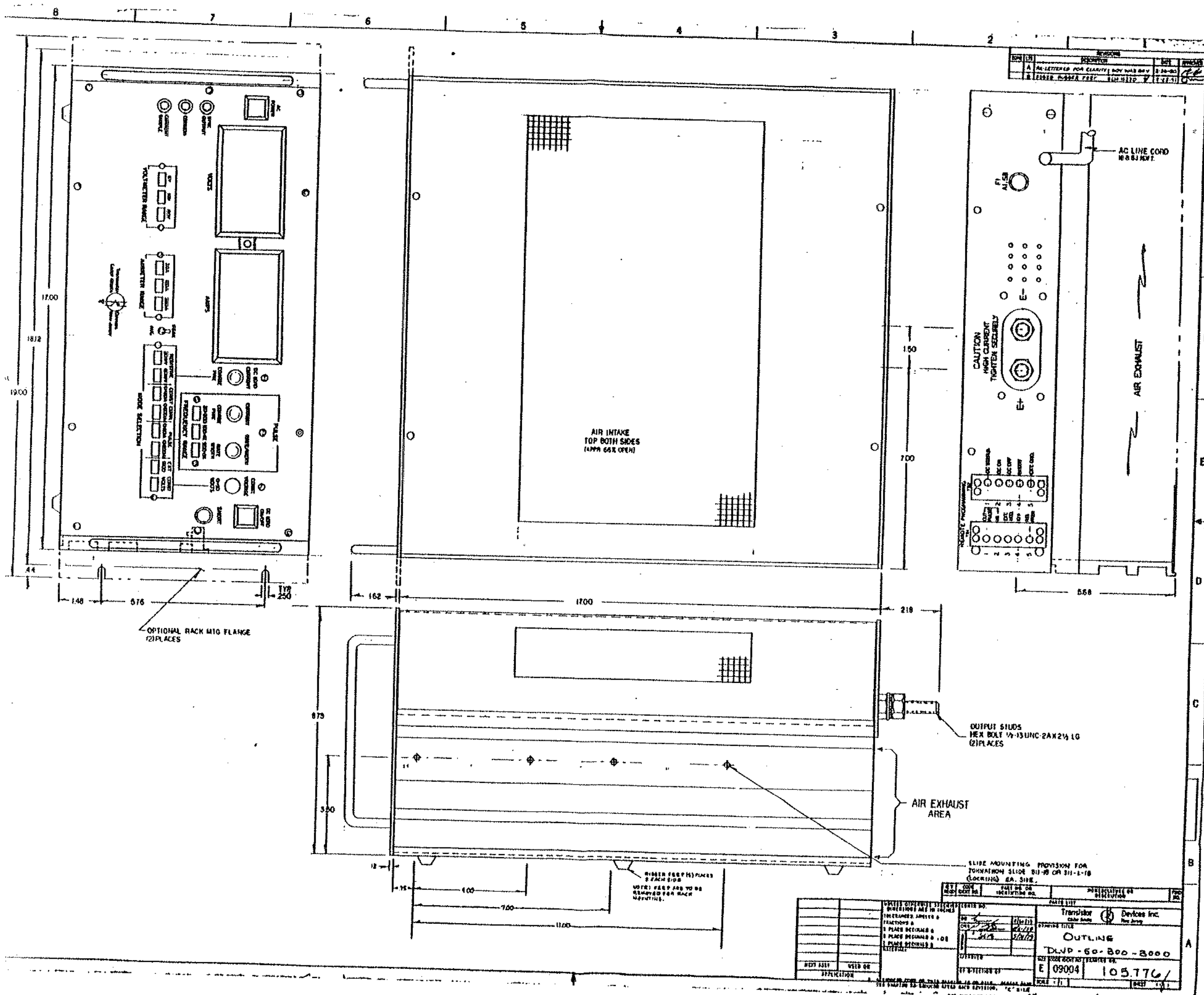
QTY REQD	ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
	CR173 THRU CR178	RECTIFIER	1N645	QPL
	Q137 THRU Q147	TRANSISTOR	2N3055	QPL
	Q148	TRANSISTOR	2N5039	QPL
	Q149	TRANSISTOR	2N3055	QPL
	Q150	TRANSISTOR	NOT USED	
	Q151	TRANSISTOR	2N3055	QPL
	Q152	TRANSISTOR	NOT USED	
	Q153 THRU Q159	TRANSISTOR	2N3055	QPL
	Q160	TRANSISTOR	2N5039	QPL
	Q161	TRANSISTOR	2N3055	QPL
	Q162	TRANSISTOR	NOT USED	
	Q163	TRANSISTOR	2N3055	QPL
	Q164	TRANSISTOR	NOT USED	
	Q165 THRU Q171	TRANSISTOR	2N3055	QPL
	Q172	TRANSISTOR	2N5039	QPL
	Q173 THRU Q178	TRANSISTOR	2N3055	QPL
	R137 THRU R147	RES. .15, 5W, 10%	CP5	DALE
	R137A THRU R147A	RES. 470, ¼W, 10%	RCR07G471KS	QPL

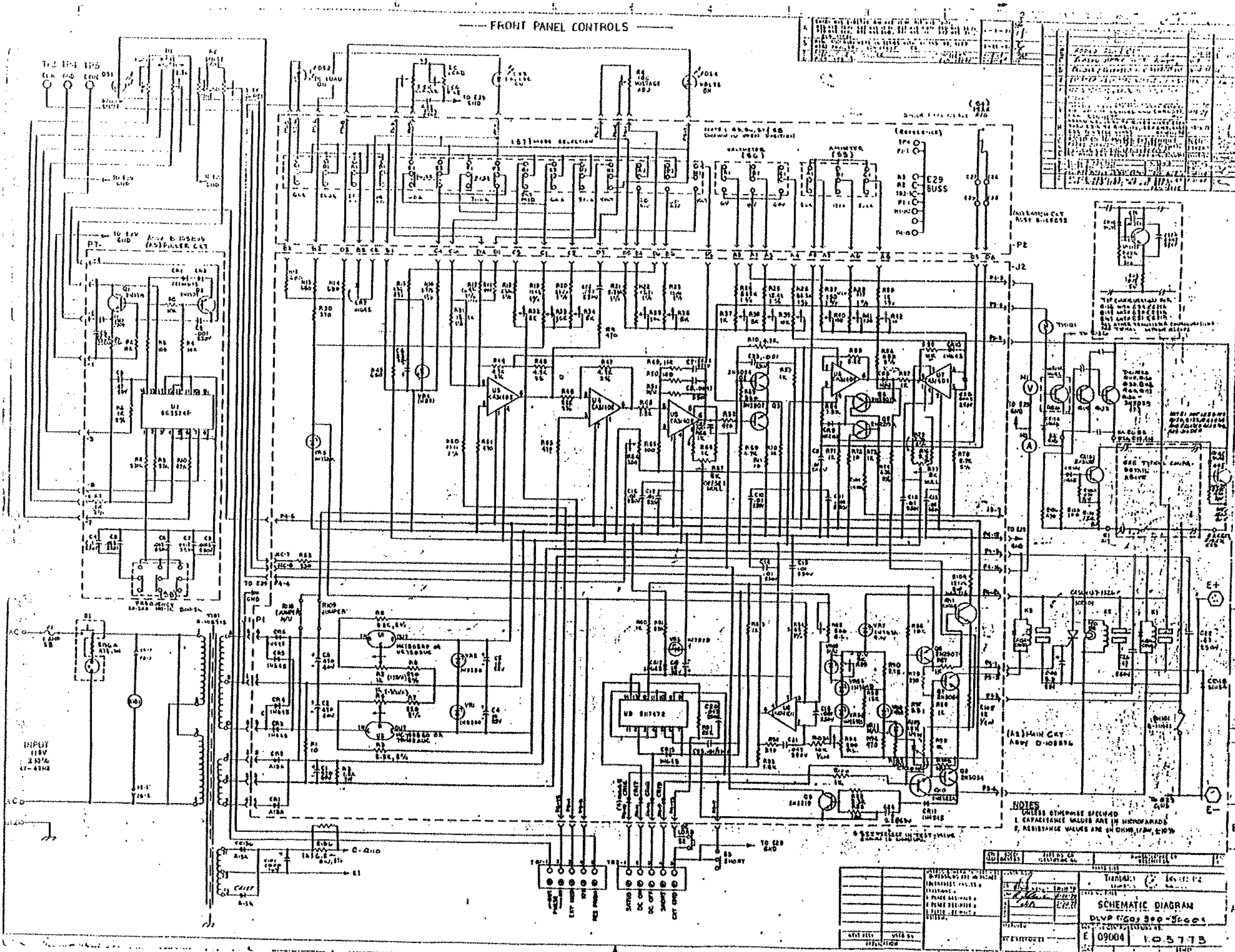
ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
R148	RES.	NOT USED	
R148A	RES.	NOT USED	
R149 THRU R151	RES. .15, 5W, 10%	CP5	DALE
R149A THRU R151A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
R152	RES.	NOT USED	
R152A	RES.	NOT USED	
R153 THRU R159	RES. .15, 5W, 10%	CP5	DALE
R153A THRU R159A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
R160	RES.	NOT USED	
R160A	RES.	NOT USED	
R161	RES. .15, 5W, 10%	CP5	DALE
R161A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
R162	RES.	NOT USED	
R162A	RES.	NOT USED	
R163	RES. .15, 5W, 10%	CP5	DALE
R163A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
R164	RES.	NOT USED	
R164A	RES.	NOT USED	
R165 THRU R171	RES. .15, 5W, 10%	CP5	DALE
R165A THRU R171A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
R172	RES.	NOT USED	
R172A	RES.	NOT USED	
R173 THRU R178	RES. .15, 5W, 10%	CP5	DALE

ITEM NO	NOMENCLATURE or DESCRIPTION	PART or IDENTIFYING NO	APPD MFR or EQUIV
R173A THRU R178A	RES. 470, ¼W, 10%	RCR07G471KS	QPL
C30	CAP. .01 MFD, 250V	C280AE/A10K	MEPCO ELECTRA
C30A	CAP. .047 MFD, 250V	C280AE/A47K	↓
C31	CAP. .01 MFD, 250V	C280AE/A10K	↓
C31A	CAP. .047 MFD, 250V	C280AE/A47K	MEPCO ELECTRA
	* SELECT IN TEST--NOMINAL VALUE SHOWN.		
J8	CONNECTOR, CABLE, 2 PIN	1625-2-03-06-1022	MOLEX
P8	CONNECTOR, CABLE, 2 PIN	1625-2-03-06-2022	MOLEX
---	PINS, CABLE CONNECTOR	1561TL (02-06-1103) FEMALE	MOLEX
---	PINS, CABLE CONNECTOR	1560TL (02-06-2103) MALE	MOLEX

or item - see source control or specification control drawing TRANSISTOR DEVICES INC. CEDAR KNOLLS, N.J.

DLVP 50-300-3000A	CODE IDENT NO 09004	SIZE A	PL	105774
	SCALE			SHEET 13 of 13


AC LINE CORD
AIR EXHAUST
CAUTION
HIGH CURRENT
TIGHTEN SECURELY
AIR INTAKE
TOP BOTH SIDES
(APPR 66% OPEN)
VOLTS
AMPS
PULSE
FREQUENCY RANGE
VOLTMETER RANGE
AMMETER RANGE
MODE SELECTION
OPTIONAL RACK MTG FLANGE
(2) PLACES
OUTPUT STUDS
HEX BOLT 1/2-13UNC-2AX2 1/2 LG
(2) PLACES
AIR EXHAUST
AREA
1.50
7.00
17.00
18.12
19.00
.44
1.48
5.76
TYP
2.50
1.62
2.18
5.58
8.75
3.50
.12
.75
4.00
11.00
Transistor Devices Inc.
OUTLINE
DLVP-60-800-3000
E 09004
105.776



FRONT PANEL CONTROLS
E29 BUSS
INPUT
NOTES
SCHEMATIC DIAGRAM
E 09004
105773